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IS 3075-3 (1986): circlips, Part 3: Type E for shafts [PGD 2: Machine Tool Elements and Holding Devices]

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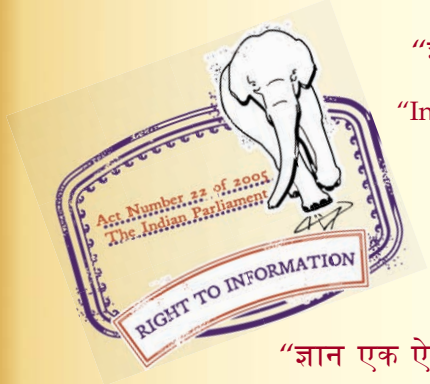

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"Knowledge is such a treasure which cannot be stolen"

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Indian Standard

SPECIFICATION FOR CIRCLIPS

PART 3 TYPE E FOR SHAFTS

(First Revision)

1. Scope

1.1 Covers the requirement of circlips — type E for shafts of nominal size range of 0·8 to 30 mm.

1.2 Additional information like load-bearing capacity and detachment speed have been given in Appendix A.

Note — Radially assembled type of circlips for smaller shafts are commonly known by the industry as 'Type E circlips'.

2. Symbols

2.1 For the purpose of this standard the following letter symbols shall apply:

a — Width of the opening of the unloaded circlip

d_1 — Shaft diameter

d'_1 — Shaft diameter to which F_N refers

d_2 — Groove diameter=nominal size

d_3 — Maximum outside diameter at seating in the groove with nominal diameter

E — Modulus of elasticity

F_N — Load bearing capacity of the groove with shaft diameter d'_1 at a yield point of the grooved material of 200 N/mm² (*see* **A-1.1**)

F_s — Load-bearing capacity of the circlip at sharp-edged abutment (*see* **1.2**)

F_{sg} — Load-bearing capacity of the circlip at edge distance g (*see* **1.2**)

R_{eL} — Yield point

g — Edge chamfering distance

m — Groove width

n — Collar width

N_{ds} — Detachment speed (*see* **A-2**)

s — Thickness of the circlip

3. Dimensions, Tolerances and Design Data

— Shall be as given in Table 1.

4. Material and Hardness

4.1 The circlips shall be manufactured from spring steel of grade such as 70C6 or 75C6 conforming to IS : 2507-1975 'Specification for cold rolled steel strips for springs (*first revision*)'.

4.2 Hardness of circlip shall be between 460 to 580 *HV* (corresponding to 46 to 54 HRC).

Note — Hardness values converted as per IS : 4258-1982 'Hardness conversion tables for metallic materials (*first revision*)'.

5. Designation

5.1 A circlip of groove diameter (nominal size) d_2 = 24 mm shall be designated as:

CIRCLIP 24 IS : 3075 (Part 3)

6. Finish

6.1 All sharp edges shall be removed from the circlips. The circlips shall be free from burrs, cracks, laminations and other defects.

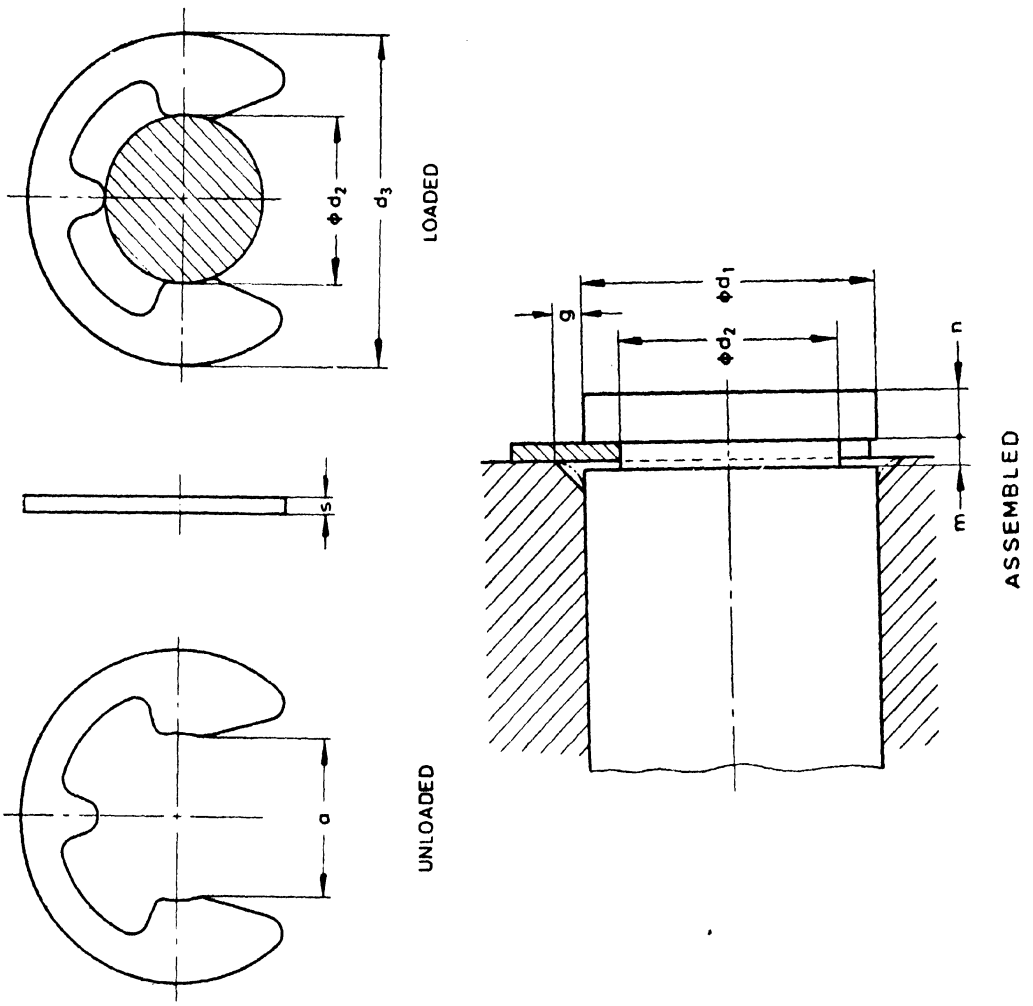
Adopted 25 November 1986 © January 1988, BIS Gr 3

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

TABLE 1 DIMENSIONS AND DESIGN DATA FOR CIRCLIPS — TYPE E

(*Clause* 3)

All dimensions in millimetres.



AMENDMENT No. 1 OCTOBER 1997
TO
IS 3075 (PART 3) : 1986 SPECIFICATION FOR CIRCLIPS
PART 3 TYPE E FOR SHAFTS

(First Revision)

(*Page* 1, *clause* 4.2) — Substitute '460 to 560 *HV* (corresponding to 46 to 52 HRC)' *for* '460 to 580 *HV* (corresponding to 46 to 54 HRC)'.

(PE 02)

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Groove Dia, d_1 Nominal Size	Shaft Dia Range, d_1		Circlip				Groove					Design Data†					
			s		a		d_2		m*		n Min	d_3 Max	F_N		F_s	g	F_{sg}	N_{ds}
	From	To	Size	Tolerance	Size	Tolerance	Size	Tolerance	Size	Tolerance			kN	at d'_1	kN		kN	Min^{-1}
0·8	1	1·4	0·2	± 0·02	0·58	± 0·04	0·8	0 − 0·04	0·24	+0·04 0	0·4	2·25	0·03	1·2	0·08	0·3	0·04	50 000
1·2	1·4	2	0·3		1·01		1·2	0 − 0·06	0·34		0·6	3·25	0·04	1·5	0·12	0·4	0·06	47 000
1·5	2	2·5	0·4		1·28		1·5		0·44		0·8	4·25	0·07	2	0·22	0·6	0·11	43 000
1·9	2·5	3	0·5	± 0·03	1·61		1·9		0·54	+0·05 0	1	4·8	0·10	2·5	0·35	0·7	0·17	40 000
2·3	3	4	0·6		1·94		2·3		0·64		1	6·3	0·15	3	0·50	0·9	0·24	38 000
3·2	4	5	0·6		2·70		3·2	0 − 0·075	0·64		1	7·3	0·22	4	0·65	0·9	0·32	35 000
4	5	7	0·7		3·34	± 0·048	4		0·74		1·2	9·3	0·25	5	0·95	1	0·47	32 000
5	6	8	0·7		4·11		5		0·74		1·2	11·3	0·90	7	1·15	1	0·60	28 000
6	7	9	0·7		5·26		6		0·74		1·2	12·3	1·10	8	1·35	1·1	0·70	25 000
7	8	11	0·9		5·84		7	0 − 0·09	0·94		1·5	14·3	1·25	9	1·80	1·3	1·00	22 000
8	9	12	1	± 0·04	6·52	± 0·058	8		1·05		1·8	16·3	1·42	10	2·50	1·5	1·25	20 000
9	10	14	1·1		7·63		9		1·15		2	18·8	1·60	11	3·00	1·6	1·50	17 000
10	11	15	1·2		8·32		10		1·25		2	20·4	1·70	12	3·50	1·8	1·75	15 000
12	13	18	1·3		10·45	± 0·07	12	0 − 0·11	1·35	+0·08 0	2·5	23·4	3·10	15	4·70	1·9	2·30	13 000
15	16	24	1·5	± 0·05	12·61		15		1·55		3	29·4	7·00	20	7·80	2·2	3·30	11 000
19	20	31	1·75		15·92		19		1·80		3·5	37·6	10·00	25	11·00	2·5	3·60	7 600
24	25	38	2	± 0·06	21·88	± 0·084	24	0 ± 0·13	2·05		4	44·6	13·00	30	15·00	3	4·00	5 500
30	32	42	2·5		25·80		30		2·55		4·5	52·6	16·50	36	23·00	3·5	5·30	4 200

*The dimensions specified for groove width m are applicable for general application. For high precision applications and in cases of alternate loading, closer groove width can be chosen. Where accuracy is not so important, wider groove widths can also be specified.

†The design data applies to circlips of spring steel as per IS : 2507-1975 'Specification for cold rolled steel strips for spring (*first revision*)'.

6.2 Unless any alternative finish is specified by the purchaser, the circlip shall be chemically and/or thermally blackened or phosphated to class A2 of IS : 3618-1966 'Phosphate treatment of iron and steel for protection against corrosion'. The coated circlips shall be subjected to appropriate treatment to avoid hydrogen embrittlement.

Note — In the case of circlip with electroplated surface protection, the upper limit of thickness '*s*' may be exceeded according to the film thickness of the plating required. This shall be taken into account in the design of the groove.

7. Tests

7.1 *Testing of Material*

7.1.1 Vickers hardness test in accordance with IS : 1501 (Part 1) - 1984 'Method for Vickers hardness test for metallic material : Part 1 HV 5 to HV 100 (*second revision*)'.

7.1.2 Rockwell hardness test in accordance with IS : 1586-1968 'Methods for Rockwell hardness test (B and C scales) for steel (*first revision*)'. In case of doubt, the Vickers hardness test applies. For circlips, the hardness test is regarded as a destructive test.

7.2 *Testing of the Toughness*

7.2.1 The circlip shall be assembled radially on to a hardened shaft with a diameter of 1·1 d_3 (nominal size) and kept at ambient temperature for 48 h. The circlip shall not break.

7.3 *Testing of Flatness*

7.3.1 The circlip shall pass through two parallel planes with a clearance of 1·1 *s* (nominal size).

7.4 *Testing the Function (Permanent Set and Grip Test)*

7.4.1 The circlip shall be assembled five times radially on to a hardened shaft of diameter d_3 (minimum size) and disassembled four times. The circlip shall still sit with force at the fifth assembly.

7.5 *Acceptance Testing*

7.5.1 Table 2 applies to the feature while Table 3 applies for the acceptable quality level (AQL).

TABLE 2 FEATURES FOR ACCEPTANCE TEST

Features
Circlip thickness, *S*
Opening width, *a*
Flatness (form deviation)
Function (permanent set)

TABLE 3 ACCEPTABLE QUALITY LEVEL

Acceptable Quality Level (AQL)*	
For Testing of Features	For Testing of Faulty Parts
1	1·5

*Refer IS : 2500 (Part 1) - 1973 'Sampling Inspection tables: Part 1 Inspection of attributes and by count of defects (*first revision*)'.

8. Preservation and Packing

8.1 A suitable anti-corrosive surface treatment shall be given to the circlips for protection during transit.

8.2 Unless otherwise specified the circlips shall be packed in cartons of 100, 500 and 1 000 or multiples thereof. Each carton shall contain circlips of one size only.

9. Marking

9.1 The label on the carton shall carry the designation, number of pieces and the manufacturer's name or trade-mark.

9.2 *Certification Marking* — Details available with the Bureau of Indian Standards.

APPENDIX A

(*Clause* 1.2)

ADDITIONAL INFORMATION FOR LOAD BEARING CAPACITY AND DETACHMENT SPEED

A-1. Load Bearing Capacity — A circlip connection requires separate calculations for load bearing capacities of the groove F_N and for the load bearing capacity of the circlip F_s. In each case the weaker part is that which applies. The load bearing capacities listed in **3** (F_N, F_s, F_{sg}) contain no safety against yielding under fluctuating stress. There is at least twice the level of safety against fracture under static stress.

A-1.1 *Load Bearing Capacity of Groove*, F_N — The F_N values in Table 1 (load bearing capacity of the groove) are applicable to grooves in parts made out of materials up to 200 N/mm² yield point, for collar lengths *n* and refer to the shaft diameter d'_1.

The load bearing capacity F'_N for materials with yield point R'_{eL} deviating from 200 N/mm² is directly proportional to the yield point.

$$F'_N = F_N \cdot \frac{R_{eL}'}{200}$$

The load bearing capacity of the groove F'_N in case of shaft diameter d_1 deviating from d_1' is calculated using the formula:

$$F'_N = F_N \cdot \frac{d_1 - d_2}{d'_1 - d_2}$$

A-1.2 *Load Bearing Capacity of Circlip* F_s — The load bearing capacity of the circlip F_s according to **3** is applicable for a sharp edge abutment of the mating machine part (*see* Fig. 1).

The values F_{sg} are applicable for an abutment with edge chamfering distance *g* (chamfering or rounding) (*see* **3**, read with Fig. 2).

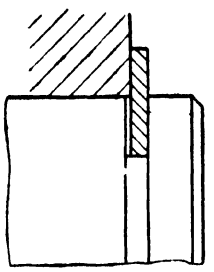

FIG. 1 ABUTMENT WITH SHARP EDGE

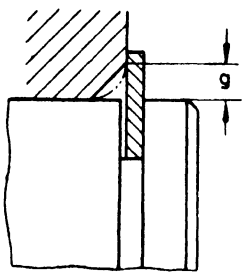

FIG. 2 ABUTMENT WITH CHAMFERED OR RADIUSED EDGE

Both values F_s and F_{sg} are applicable for circlip materials with a modulus of elasticity (Young's modulus, *E*) of 210 000 N/mm². If circlips made of any other material with a different Young's modulus *E'* are used, the load bearing capacity of the circlip is directly proportional to the Young's modulus *E*:

$$F'_s = F_s \cdot \frac{E'}{210\,000}$$

$$F'_{sg}{}' = F_{sg} \cdot \frac{E'}{210\,000}$$

If the edge chamfering distance *g'* deviates from those given in **3**, the load-bearing capacity of the circlip is inversely proportional to the edge distance.

$$F'_{sg} = F_{sg} \cdot \frac{g}{g'}$$

Note — *F'* in case of smaller values of *g'* is greater than *Fs*, then F_s applies.

A-2. Detachment Speed (N_{ds})

A-2.1 The application of circlips is limited by those speeds which can lead to a lifting of the circlips.

Therefore detachment speeds N_{ds} at which this lifting can occur are specified in 3. The values are applicable only for circlips made out of spring steels as specified in 4.

EXPLANATORY NOTE

This standard was issued in 1965 as a comprehensive standard based on Draft DIN 6799-1963, for dimensions. Consequently, DIN standard was revised completely with the inclusion of testing and acceptance requirements. However the sizes and range remain the same, as that of earlier DIN revision. This standard is being revised to bring it in line with the DIN standard.

Circlips made from carbon spring steel strips or bars serve as radial spring fasteners for positioning and retaining components in assembly. Normally the circlips are either axially assembled (either over shafts or inside bores) or radially assembled over shafts.

When the circlips are assembled, a portion of the ring protrudes from the groove to form a shoulder to support the abutting part. The part to be retained may be; a ground thrust washer having a full surface contact with the shoulder providing a sharp-cornered abutment, or a ball bearing with a radiused edge which will have contact with only a portion of the shoulder; or a gear wheel with a chamfered edge which will also have contact with only a portion of the shoulder. The large corner radius or chamfer will result in a different type of assembly from that of the sharp cornered abutment.

Thus the fastening system using circlips depends on three elements that is the circlip, the groove and the retained part. In case of axial load transmission, the circlip serves as a means of transferring the load from the retained part to the groove wall. However, in cases of impact loading, the energy absorbing capacity of the circlip will be an important factor. The more the energy absorbed, the less will be transferred to the grooved wall.

This standard dealt with the dimensions and other requirements for all types of circlips. In the present revision, this standard has been divided into three parts to bring it in line with relevant DIN standards. Testing, acceptance criteria, packaging and BIS certification marking clauses have also been included.

This Part 3 of the standard covers requirements of the circlips of radially assembled type, most commonly known as 'E' type, used for smaller shafts. In addition to this, the requirements of circlips, axially assembled over shafts having diameters 3 to 300 mm, normal and heavy types have been covered in Part 1 of this standard.

Other two parts of the standard in this series are:

Part 1 Specification for circlips for shafts

Part 2 Specification for circlips for bores

Printed at Simco Printing Press, Delhi, India